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Article

Which factors influence attentional functions? Attention assessed by KiTAP in 105 6- to 10-year-old children

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Abstract: This research revealed the children with difficulties in attentional functions in healthy children attending primary school and aimed to identify the possible socio-demographic factors such as child's age, gender and school's grade that could influence attentive performance. The participants were 105 children aged 6-10 years (M age=8.6; *SD*=1.04), 57 females, attending primary schools. Family economic condition attested mostly at a medium level (63.5%) and parents had more frequently 13 years of schooling. The computerized test KiTAP was administered to children to assess attentional functions. Results showed higher frequency of omissions and false alarms and a reduced speed in Alertness, Go/No go and Sustained Attention tasks comparing to Italian norms. A series of hierarchical regression analyses were run with school grade, gender and current age as independent variables and mean reaction times (and standard deviation), number of omissions and of false alarms as dependent ones. Results showed male gender and attending a lower primary school grade impacting on lower attentional performance in several subtests. Females showed the best performances in distractibility and impulsive reaction tendencies tests, while higher school grade positively influenced the divided and sustained attention. These results could be useful to identify children with major attentional difficulties and some recommendations for futures studies and implement attention empowerment programmes were proposed.

Keywords: Attentional functions; primary school; KiTAP; healthy children; gender; delays

1. Introduction

1.1 Definition of attention and adopted theoretical model

The attention has been identified as a complex construct in psychology, not expressing a unitary concept, but concerning a psychological phenomenon that interacts with all other cognitive processes, such as perception, memory, behavioral planning or actions, linguistic production, spatial orientation [1]. Attentional skills are a prerequisite for responding to daily environmental demands and that through them the person could select and integrate all the relevant information he/she perceives, coming from different sensory channels, associating them with conceptual superior categories. Besides the cognitive ones, the motivational and emotional processes have been recognized to have an important role too: what is perceived as not interesting, without an affective value, does not become a subject of attention.

Numerous studies have been conducted on the construct of attention, studies that have evolved and refined over the years. In the present study on attention in primary school children we adopted "The Aspects of Attention" model by Van Zomeren & Brouwer [2]. The two authors schematized the basic processes of attention by grouping them into two main components: selectivity and intensity.

Within selectivity, they distinguished "Focused Attention" and "Divided Attention", while incorporating in intensity "Alertness" and "Sustained attention " (or "Vigilance") (Figure 1)

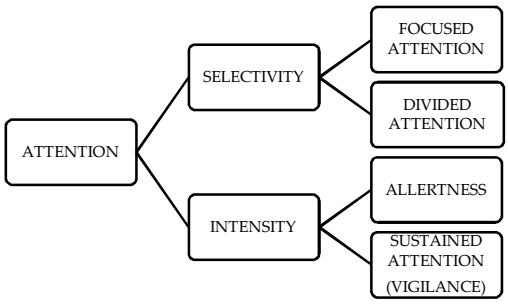

Figure 1: Supervisory Attentional Control (SAC), Van Zomeren and Brouwer's Basic Process Sketch, 1994 [2], (in [3], p.184)

Attention has been significantly associated with fine motor control from 5 to 11 years old, so a possible delay in attentional performance could influence other important children's development abilities [4].

1.2 Factors influencing attention performance in school context

The strong inter-individual variability in attention performances depends on a number of factors, both constitutional and environmental, that determine the different developmental paths that attention could follow. Thus, as with all cognitive skills being developed, to be understood and evaluated as fully as possible, consideration should be given to the child's characteristics, taking into account the influence of many factors [5]: biological characteristics of the child, maturation levels of the central nervous system (CNS), general cognitive and emotional capacity of the child, and, finally, environmental variables, namely his/her personal experiences, context in which he/she lives. School is one of the most significant and privileged developmental context for the child. With the attendance of primary school, the child faces new developmental challenges compared to early childhood, which will lead him/her to an important cognitive, emotional and social evolution [6]. The class child attends, people around him/her, and everything defining the child in his/her specificity assume an important role in attention performance.

1.2.1 Role of age

Attentional functions, like all the cognitive mechanisms, are primarily affected by the level of cerebral maturation. Throughout childhood and until adolescence, the so-called "executive" attention will be defined to control behaviors, to distribute cognitive resources, to plan and direct action to achieve specific goals [7]. This could not happen if the central nervous system and the targeted networks do not mature.

Zimmermann & Fimm [8] studied the general development of attention in healthy children aged 6 to 12 years. Despite the unavoidable inter-individual differences, they observed that increasing age inevitably increased the quality of performances to attentional tests and that they, initially very heterogeneous, tended to stabilize. Reaction times, for example, very different in children aged 6/7 years, decreased as their age increased, and seemed to stabilize only at the age of 13/14 years. Flexibility, important to control the focus of attention, also grew with child maturation. In addition, the results for split attention tests showed how it was influenced by age. The influence of age was more evident on performance speed than on its quality in 5- to 11-year-old Arab children, with rapid improvement until the age of 9 years, with some attentional functions (alertness and inhibitory control) that seemed to develop earlier than other functions (distractibility and divided attention) [9]. Age was negatively associated with distractibility, lapses of attention and cognitive speed, indicating that these parameters decrease with age in healthy children [10]. Number of errors (incorrect

responses to critical stimuli) and omissions (missed responses to critical stimuli) were found to be critical attention's scores for academic performance in primary school children and seemed to constitute a sensitive measure of distraction.

1.2.2 Role of gender

Literature - for example, Biedereman et al. [11], or Siegel & Smythe [12] - offered a wide range of studies that have investigated the most influential factors in attention development according to gender, but in cases of disorder or pathology. For example, it was noted that Attention Deficit and Hyperactivity Disorder (ADHD) affected more males, according to a ratio ranging from 3 to 9. Gender-related differences were observed also in some KiTAP subtests: males had faster reactions times, but were less accurate than females [9].

1.2.3 Role of family factors

The role of family's influences on preschool and school age cognitive development has received considerable empirical attention from cognitive developmental psychology researchers in the last few decades [13]. The literature showed that family's socio-economic condition could influence the child's attention performance, and a recent meta-analysis [14] showed how the Socio Economic Status (SES) disparities played a relevant role on the executive function performance among children. Families with a low cultural level and income compared to average/high ones showed a considerably higher presence of ADHD. The importance of maternal education for children's academic outcomes was widely recognized [15]. The siblingship size did not show to limit children's cognitive development during early childhood [16].

In conclusion, like all cognitive processes, attention has been mainly linked to continuous and bidirectional interaction between genes, biological structures and functions on the one hand, and environmental factors on the other [17].

1.3 Gap in the literature: Attention in healthy children

A review of the literature on attention in children revealed that studies and research that specifically investigated the development and characteristics of the attentional mechanisms of healthy children during the primary school period were not numerous at all. For example, a large part of studies investigating attention's activation took into account many other cognitive processes with the aim to determine reciprocal influences. Furthermore, developmental studies on children's attentional skills were limited to clinical targets, such as children with difficulty or disturbance of attention [18-20].

Specific and shared information on attentional skills, their development, and their characteristics in healthy school aged children were lacking in the literature. Time variability in a go/no go task, followed by number of errors in a divided attention task and response time variability in an alertness task [21] have been identified as the best measures to discriminate between children with and without attention difficulties.

1.4 Research goals

1. The main objective of this study was to identify children with attentional deficit attending primary school comparing their scores with the Italian relative norms.

2. We expected that attentional functions could improve with growing age, when the child is attending the last two school classes [8, 22]. The literature was divided on this topic: according to some authors, attentional functions improved by increasing age, while, according to others, improvements with age were not significant [22-23]. In addition, as emerged from the studies of Zimmermann & Fimm [8], we intended to investigate whether the attentional performance underwent a marked improvement in eight-year-old children due to the maturation of the specialized brain areas, both through experience and school learning.

3. We expected to find gender differences in attentional functions [11, 12]. In fact, some studies [24] revealed that males, for constitutional reasons, were less likely than females to stay focused, firm and alert, while had faster reaction times [9].

4. We wanted to verify if children's family socio-economic context could influence attentional functions, specifically if socio economic status disparities could influence executive function performance among children [14].

5. We aimed to understand if the presence of siblings or parents' level of education could influence the quality of the children's attentional performance [15, 16].

With regard to the last two research questions, literature emphasized that a good growth environment, which adequate stimulation, facilitated the development not only of the attention but of all the most important cognitive abilities [17]. Confirming this, there were data from studies that found a strong correlation between children with ADHD and a low socio-cultural and economic family condition [14].

2. Materials and Methods

2.1 Participants

The participants were 105 children aged 6-10 years old with a mean age of 8.6 (*SD*=1.04), 57 females, attending three primary schools in a North-East region of Italy, from the second year of school to the fifth/last year. We received a valid consent form from 115 families on 132 contacted, response rate being 87.12%. Ten children were not reached in the assessments for logistic problems (teachers' other priorities during the school lessons, ill children in the data collection period, no quiet room available for assessments). Table 1 shows socio-demographic information for the participants and table 2 shows family's socio-demographic characteristics.

Table 1: Socio-demographic characteristics

Class	N	Males	Females
2nd	19 (18.1%)	5	14
3rd	42 (40%)	21	21
4th	27 (25.7%)	13	14
5th	17 (16.2%)	9	8
Total	105 (100%)	48	57

Table 2: Family's socio-demographic characteristics

		Mothers	Fathers
		Frequency	Frequency
Education (Years of schooling)	5 ys	1%	1.1%
	8 ys	26.8%	35.1%
	13 ys	60.8%	53.2%
	16 ys	5.2%	2.1%
	18 ys	5.2%	7.4%
	>18 ys	1%	1.1%
Employment	Looking for a job	19.7%	3.1%
	Part-time	50%	3.1%
	Full-time	30.3%	93.8%
Weekly job hours	50 or more	1.6%	17.6%
	40-49	16.1%	61.5%
	30-39	37.1%	18.7%
	20-29	38.7%	2.2%
	10-19	3.2%	0%

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	0-9	3.2%	0%
		Mean (SD)	Mean (SD)
Current Age		40.11 (4.36)	43.01 (4.56)
		FAMILY	
		Frequency	
Relationship status	Married	89.1%	
	Divorced/Separated	5.5%	
	Cohabitant	5.4%	
	Single	0%	
Economic situation perceived	Low	21.9%	
	Medium	63.5%	
	High	14.6	
Home situation	Rent	6.1%	
	In progress mortgage	45.9%	
	Finished mortgage	37.8%	
	Other	10.2%	
	Range	Mean (SD)	
N° of familiars	2-6	3.9 (0.75)	
N° siblings	1-3	1.2 (0.49)	

2.2 Procedure

The project was successfully proposed to the Director of the school who, illustrated it to the institute councils. A letter explaining the research project was sent to families of students attending the second to the fifth grade, requesting the participation to the study through an attached informed consent form. The exclusion criterions were: no history of chronic illness or injury and absence of sensory deficiencies and other pathological aspects. First-class children were not involved as the trial might be too tiring for them, especially for data collection period that was just at the beginning of the school year (from October to December).

Out of more than 500 letters sent, 132 returned with permission to participate, but 17 children were excluded because the informed consent had been signed by just one parent. From these families, 74 filled in the socio-demographic survey and 105 children completed the attention's assessment.

Students were met individually in a silent and empty room where the laptop with KiTAP for the assessment was located. Each student was assessed in 6 of the full 8 battery tests. Administering the entire battery would have meant asking the child to be engaged for almost an hour and a half, a time too long that would have definitely affected the quality of his performance and difficult to be included in regular school activities. So Vigilance and Visual Scanning subtests were removed from the test for time-constrains.

At the end of the test the psychologist always thanked the participant, stressing the importance of his contribution. Overall, the administration lasted 30 minutes for the oldest and fastest students; 45 minutes, with the younger ones.

Scores obtained from each subject in each test were stored automatically. They were placed in a table that provided information about the subject, the examiner, and reaction times (RT) for each trial. In addition, there was a list of results with the data of the individual parameters, namely mean, median and standard deviation of RT, number of correct and incorrect reactions and number of omissions. Scores were expressed in percentiles or in T points. The program also offered graphs.

2.3 Instruments

2.3.1. KiTAP [8, 28-29]

This test has been created to ensure optimal motivation for children during attention testing by providing a design suitable especially for younger children. By increasing motivation and compliance, validity of test should be maximised.

Great importance has been attributed to the attentional functions of school-age children. Assessing attention in school children is crucial for several different diagnostic questions. There has been a current lack of test instruments specifically designed to provide a differential measure of young school children's attentional abilities.

The battery Test of Attentional Performance for Children KiTAP has been constructed with particular attention to the same consideration that applied to the adult version of the test (TAP). The choice of KiTAP's tests has been based on the analysis of data from 148 children between the age of 6 and 10 years tested with TAP. A factor analysis of the data has revealed a factor structure with five independent aspects or factors, which have been represented by a TAP subtest.

The factors are: "Speed" (Alertness),"Flexibility" (Flexibility), Divided attention" (Divided Attention), "Reaction control" (Go/No go), "Visual scanning performance" (Visual Scanning), "Distractibility", "Vigilance" and "Sustained Attention". Table 3 shows KiTAP's parameters.

Alertness ("the witch"): is a central aspect of attentional intensity. Intrinsic alertness is measured with a simple reaction task. In this test a witch appears at a window and should be driven away as fast as possible by pressing the key. The median provides information on processing speed, while standard deviation indicates how much alert during the test can be maintained stable. In addition, comparing the performance of children encountered with the performance of the KiTAP normative values, the percentile median and the standard deviation in percentile were calculated.

Table 3. Parameters in each KiTAP's subtest

Test	Execution time	Parameters
Alertness	1.5 minutes	Reaction times (RT): Mean, Median, Standard Deviation
Distractibility	3 minutes	RT Median, Omissions, False alarms
Divided attention	4.5 minutes	RT Median, Omissions, False alarms
Flexibility	1.5-2 minutes	RT Median and RT Median in percentiles, False alarms and False alarms in percentiles
Go/NoGo	2.5 minutes	RT Median, Omissions, False alarms
Sustained attention	10 minutes	RT Median, Omissions, False alarms

Distractibility ("the sad and the happy ghost"): One of the fundamental aspects of focused attention is the ability to intentionally maintain control over the focus of attention in complex situations and under distracting conditions. Younger children stand out because of their high level of distractibility, through which they frequently lose sight of their goals from one moment to the next when something else captures their attention. A low degree of distractibility is therefore an important prerequisite for concentrated work and is of particular importance for school aged children. The purpose of this test is to perform a centrally presented decision task, while in half the trials a distracting stimulus appears in the periphery of the visual field. The central stimulus, a cheerful or sad ghost, is designed so that the distinction between cheerful and sad is only possible by focusing visually. The assessed parameters are number of omissions and false alarms: the first indicate the degree of distractibility of the subject, the second indicate when he reacted according to a "suspicion" and not for having really recognized the stimulus. In addition, the two parameters were considered as percentiles, so that we could compare our sample with norms. Scores were considered both in "distractor" state and "no distractor" state.

Divided attention ("the owls"): A common experience in daily life is that of paying attention to a number of things or events at once. This requires the ability to divide attention between simultaneously occurring events. In the present test a sequence of acoustic and visual stimuli has to

be observed simultaneously in order to respond to critical acoustic or visual stimulus by pressing a key. One sees an owl sitting in a window which closes its eyes from time to time. This change should be reacted to. Simultaneously two owls calling each other can be heard in the background. This test is available in a simple and complex version. Number of omissions, median reaction times and false alarms, both for acoustic stimuli and visual stimuli were measured. Number of omissions is the most important parameter as it indicates the ability to divert the attention from different tasks.

Flexibility ("the dragons' house"): Selective attention refers not only to the ability to direct attention toward single events and stimuli, but also to redirect attentional focus according to current demands of a situation. The term "flexibility" is used to refer to ability to intentionally regulate and redirect attention focus. In this test two dragons of different colour (green and blue) appear to the left and right of the centre of the monitor (a gate) simultaneously. The target stimuli alternate: to begin with, the key has to be pressed on the side at which the green dragon appears. At the next presentation, the key has to be pressed on the side at which the blue dragon appears. Number of false alarms committed and median of reaction times are the parameters considered and respective percentiles are calculated for a comparison with the performance of KiTAP normative scores.

Go/No go ("the bat"): Attention comprises not only the control processes through which we take in information from the environment, but equally the control of our reactions and of our behaviour. This includes the decision as to whether and how we should react as well as the continual, e.g. visuo-motor, control of actions. One of the fundamental processes in this connection is control of impulsive behaviour, that is, ability to suppress an inappropriate reaction. The simplest way to measure impulsive reaction tendencies is by means of the so-called Go/No go task. In this test one sees either a vampire bat or a cat, whereas only the bat should be reacted to. The number of false alarms indicate the ability to inhibit the reaction and the mean of reaction times, which indicates the speed of decision-making ability. In addition, in order to compare number of alerts made by our sample with those made by the normative sample, number of percentile errors was considered.

Sustained attention ("the ghosts ball"): In this task the effortful maintenance of selective attention over a longer span of time is tested. In contrast to vigilance, where performance requires the detection of infrequent stimuli that are hard to discriminate and are presented under experimental conditions of extreme monotony, demands with sustained attention are more complex. Conditions of sustained attention or concentration are more characteristic of daily life demands. This task requires comparing a stimulus with a subsequent stimulus in order to determine whether these two stimuli have a predetermined stimulus feature in common. Stimuli to be compared are ghosts of different colour that appear consecutively at different windows of a castle ruin. This procedure places demands on working memory and flexibility, and in a more complex variant, on the ability to divide attention, since two of the stimulus aspects has to be observed. Parameters are: the number of omissions, which indicates the performance stability, and false alarms made, specifically for the first 5 minutes of the test, for the second 5 minutes, and for the total test. For the latter condition, also the number of omissions and percentile errors was considered, so that a comparison with the normative sample of KiTAP could be made.

2.3.2 Socio-demographic information

Parental education and occupational status were measured, collecting data on education (the number of years of school achievement), type and average hours of job and economic status.

2.4 Statistical analyses plan

Data were preliminary checked for normality adopting the Kolmagorov–Smirnov and Shapiro–Wilk tests. Data distribution was normal, so we decided to use parametric statistics.

To answer the research questions, we run preliminary Pearson's correlations to identify the possible significative associations between our variables. Perceived economic condition, number of siblings and parental education level were not inserted in the model because they didn't otian significative associations. Then a series of hierarchical regression analyses were run with school grade (second year of school, third year of school, fourth and fifth year of school), gender (1=male, 2=female) and child's current age as independent variables. The scores obtained at the six individual KiTAP

tests (mean reaction times and SD, number of missions and false alarms) were entered as dependent variables, one by one, choosing the parameters considered as the most significant in the test manual. We preliminary controlled for homogeneity of variance. We will show only the significative obtained results.

3. Results

For each KITAP test the Italian normative scores for the individual parameters were shown in the manual. These norms were given as percentiles. We assessed the distribution of children along these percentiles comparing the scores obtained in each subtest with those from Italian standardized norms (Table 4).

Table 4. Distribution of children's performance in standardized tests by percentiles categories

Test		<25°	25°-49°	50°-75°	>75°
Alertness	RT Median	21	16	31	37
	RT SD	32	19	27	27
Distractibility	RT Median	3	4	14	84
	Omissions	66	23	13	3
	False alarms	3	10	22	70
Flexibility	RT Median	6	14	27	59
	False alarms	28	41	14	34
Go/noGo	RT Median	9	20	31	45
	Omissions	13	77	5	10
	False alarms	33	38	18	15
Sustained attention	RT Median	14	21	26	44
	Omissions	31	26	28	20
	False alarms	46	30	19	10

Observing Table 4 we could see how a great proportion of children resulted in the lower level of percentiles categories in their scoring of false alarms and omissions in almost all the attentional tasks. Only distractibility and rapidity assessed by reaction times medians attested to normal or superior scores, even if exclusively in distractibility and flexibility subtests.

3.1 Alertness

We didn't obtain significative predictors of alertness median, reaction times and standard deviation.

3.2 Distractibility

For the first condition, with presence of the distractor on the screen, the significant model (R^2 = 0.13; F_3 = 5.33; p = 0.002) identified female gender (ß = 0.213; p = 0.014) as factor influencing the increase of distractibility RT median. On the other hand, female gender (R^2 = 0.15; F_3 = 6.23; p = 0.001) impacted as a protective factor in making false alarms (ß = -0.33; p = 0.001).

For the second condition, without distractor, the significative model (R^2 = 0.19; F_3 = 7.88; p = 0.0001) showed that discractibility RT median increased by female gender (ß = 0.38; p = 0.0001). Another hierarchical model (R^2 = 0.15; F_3 = 6.23; p = 0.001) identified gender (ß = -0.33; p = 0.0001) as the variable influencing the false alarms frequency, more frequent made in males than females.

3.3 Divided attention

Considering the condition of acoustic stimuli, the significative model (R^2 = 0.07; F_3 = 2.64; p = 0.05) identified the school grade (ß = -0.43; p = 0.03) as the factor influencing Median RT in divided attention test. By increasing the child's school grade, Median RT were lower, with a better rapidity.

Considering the condition of visual stimuli, the significative model (R^2 = 0.21; F_3 = 9.24; p = 0.0001) identified female gender (ß = -0.17; p = 0.05) and higher child's school grade (ß = -0.47; p = 0.01) as

predictors of lower Median RT in divided attention test. Different number of omissions ($R^2 = 0.10$; $F_3 = 3.97$; $p = 0.01$) resulted along child' school grade (ß = -0.55; $p = 0.008$).

3.4 Go/No Go

Gender (ß = -0.33; $p = 0.001$) influenced significantly the number of false alarms ($R^2 = 0.12$; $F_3 = 4.51$; $p = 0.005$). The same result was shown for omissions ($R^2 = 0.07$; $F_3 = 2.6$; $p = 0.05$), with gender impacting significantly (ß = -0.24; $p = 0.015$). Females had the best performance.

3.5 Flexibility

A series of hierarchilar regression analyses was performed, with child's gender, current age, and school's grade as independent variables and RT Median, RT Median in percentiles, False alarms and False alarms in percentiles as dependent ones, inserted one by one. Results showed that the number of false alarms and RT Median, both in raw score and in percentiles, didn't change significant along these demographic factors.

3.6 Sustained attention

In the first 5 minutes of testing, child's school grade (ß = -0.49; $p = 0.001$) significantly impacted on the number of omissions ($R^2 = 0.18$; $F_3 = 7.34$; $p = 0.01$). Another regression model ($R^2 = 0.26$; $F_3 = 11.83$; $p = 0.0001$) identified child's school grade (ß = -5; $p = 0.009$) as significative factor influencing RT Median. The children belonging to higher school class showed lower RT Median and made less omissions.

For the second part of the test, i.e. the last 5 minutes, the regression model ($R^2 = 0.07$; $F_3 = 2.84$; $p = 0.04$) identified female gender (ß = -0.23; $p = 0.01$) as significant factor impacting on reduced number of false alarms. Omissions were influenced significantly by child's school age (ß = -0.59; $p = 0.003$) in another regression model ($R^2 = 0.24$; $F_3 = 10.61$; $p = 0.0001$), with higher school achievement that took a better performance.

4. Discussion

To answer the first research question, we showed the distribution of children's performance in standardized tests for Italian population by percentiles categories. A great proportion of children enter the lower level of percentiles of false alarms and omissions in almost all the attentional tasks comparing with Italian norms. On the other hand, reaction times medians, that correspond to processes rapidity, is quite constant, except for alertness and sustained attention tasks, where at least a third or more falls into the categories minor than the 50th percentile, under the normative cut-off. In the distractibility test, children obtain good scores in rapidity, but at expense of accuracy, with a higher frequency of omissions of the target stimuli. We know that response inhibition tasks load mainly on central executive measures, predicting reading ability [30], so high frequency of false alarms and omissions in the Go/No go test could be precursors of reading difficulties in children.

Dealing with the second research question, the results show that for all six KiTAP tests school grade appears to be a key factor, indicating that it significantly influences the performance of students throughout the battery. Their performance along the three school grade groups varies and differs, especially for children attending the second class. Probably, from the age of 8 years there is a transition from an immature phase to a more competent one. An important increase in attentional functions performance is obtained from students attending the third year of school and it continues to get better in the last two years of primary school when they are 9-10 years. These results identify the school grade as a key factor, also controlling for chronological age, showing how the academic experience and learning through several school cycles is even more important than the chronological age. In the Alertness test no significative difference results have been found along child's school grade, chronological age or gender. The performance is stable throughout the several socio-demographic factors. Summarizing, we can state that the division of the sample in the three school grade groups is interesting, because it allows to observe the worse performances in pupils attending the second class compared to the higher classes. Chronological age is not significant in itself, but only

associated to academic level. Unfortunately, a limit of this study is given by the fact that we didn't assess children attending the first class. Further studies should take into consideration performances also among first graders enabling researchers to reach a more complete description of the development of attentional functions in childhood.

Possible gender differences [11, 12] were also investigated in the third research question. In the Distractibility test, rapidity in reaction times is mostly obtained by males, even if they commit more false alarms. This suggests that males are faster, but less accurate and focused on their task than females both in the condition with and without the distractor in the screen.

Also in the Divided Attention test children attending the last classes show the best performance, while the worst is still for 7 years-olds males attending the second class: they globally commit more omissions, especially when the target stimulus is visual. Females belonging to the lower classes show higher reaction times. Perhaps, visual target elicits more attention than the acoustic one on the screen. So 7-year-old males shows the worst ability to stay concentrated and focused on multiple tasks. When the stimulous is acoustic, the Median RT are higher in children belonging to the lower classes.

In the Go /No go test, males show more false alarms and omissions than females: probably they press the button less often and then make less mistakes.

In the Flexibility test there are no significant risk factor influencing the children's performance, but generally it is possible to note that children are really fast, but not accurate.

With regard to the last test, namely Sustained Attention, in the first 5 minutes, pupils attending the higher academic grades have the best performance, doing the fewest number of omissions and having more rapid reactions (Median RT), while the worst performances are those attending the lower classes. Male pupils committed more false alarms in the last 5 minutes. This can be explained by the nature of the test: simple and particularly monotonous, the worst performances of pupils can be caused by fatigue, especially in younger children (7 years), and boredom, especially in males that are more in difficulty to stay focused on the test.

Summarizing, the analyses conducted on the scores obtained from our sample, consisting of 48 males and 57 females, show that generally the worst performances are obtained from males for the accuracy. Comparing the performance of males and females through the three school grade groups it is noted that the number of omissions or false alarms done were generally higher for males, specifically in the go/no go and distractibility tests, while median reaction times are reduced. In KiTAP trials, therefore, girls generally have better results than males, showing that their performance are consistently better in accuracy, even if less rapid. Males are faster, but less accurate. Females attending the lower classes have more Median RT in divided attention test with the visual target in the screen.

The third question of research aimed at investigating whether the socio-economic context of the pupil's family could influence its attentional performance [14]. The economic condition isn't a factor that appears as a significant variable for attentional performance.

The fourth question involved siblings: being a single children or having siblings could affect the quality of the attentional performance? The assumption is that the presence of siblings is an important resource of rich social, emotional and cognitive stimuli [15-16]. Results from this study show that this factor doesn't affect performance in favour of having siblings, but it is necessary to consider that in our sample of 105 pupils, 78 of them had siblings and only 27 were single children, so it is difficult to exclude this factor.

413 Table 5: Summary table of hierarchical regressions results
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RESULTS	*Allertness*	*Distractibility*	*Divided attention*	*Go/Nogo*	*Flexibility*	*Sustained attention*
School grade (3-levels: 2nd class, 3rd class, 4th-5th class)	NS	NS	p<.05 Omissions visual stimuli conditions p<.05 RT Median visual stimuli conditions p<.05 RT Median acoustic stimuli conditions	NS	NS	p<.05 for number of Omissions and RT Median (first 5 min) Omissions (second 5 min)
Gender (Male/Female)	NS	p<.05 RT Median and False alarms (with and without distractor conditions)	p<.05 RT Median visual stimuli condition	p<.05 False alarms and Omissions	NS	p<.05 for number of False alarms (second 5 minutes)(second 5 min and total time)

5. Conclusions

Higher school grade matches better performance, especially in advanced attentional tasks, such as divided and sustained attention, with pupils attending the lower classes who show the worst performance independently form their chronological age. Observing these results, we can imagine how school activities and attendance impact upon advanced attentive tasks. In this study it is confirmed the distinction between basic and non-basic skills: for the basic tests (i.e. alertness, distractibility, go/no go) the performance of the lower school grade pupils is at least similar to those of their higher one companions, while in the non-basic skills (divided and sustained attention) the child's scholastic achievement became a key factor in ameliorating child's performance.

The results show that females obtained a consistently higher performance throughout the three age groups especially in the go/no go and distractibility tests. On the other hand, males report a best performance considering rapidity, even if they are less accurate.

Family factors such as presence of sibling/s, parental schooling years and socio-economic condition don't emerge as possible significant variables for a best attentional performance. Further studies with a more homogeneous sample of these variables should investigate better these aspects.

Strengths and limits

A strength of this study is the opportunity to investigate the attention in an exclusive and authentic way, without involving other cognitive abilities. The choice of KiTAP as the assessment instrument is valuable from different points of view: it is structured through very simple tests that do not require the activation of other more complex cognitive abilities, KiTAP allows a good investigation of attention and its mechanisms, even with young or inexperienced children. In addition, being a computer test presented in a play form and fantastic stories and having a fun and colourful graphic, it is bound to motivate children.

The ample number of participants involved in the project, coming all from the same geographical area, is a point of strength even if provenience can also be considered as a limit and future research will aim at involving other primary schools in other areas to have a sample more representative of all the country. Another limit is represented by the inhomogeneity of the sample along age groups, with younger children (6-7 years old) less numerous than the older ones (8, 9-10 years old). It should be important to increase the number of participants in the first age group to have a more homogeneous distribution according to age.

Future research could also focus on better understanding how family socio-economic condition affects children's abilities, and even more, to understand if parents' minor presence in the lives of children affects the quality of their attentional performance. The presence of siblings does not seem to help the child reaching better attentional functioning. It would be interesting to understand better this phenomenon, assessing also siblings' attentional functions or observing the sibling relationship during family daily life.

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